

<b>Dataset Expocode</b>	<b>09FS20120208</b>
<b>Primary Contact</b>	<b>Name:</b> Bronte Tilbrook <b>Organization:</b> CSIRO Oceans and Atmosphere <b>Address:</b> PO Box 1538, Hobart Tasmania 7001 Australia <b>Phone:</b> +61 3 6232 5273 <b>Email:</b> bronte.tilbrook@csiro.au
<b>Investigator</b>	<b>Name:</b> Tilbrook, Dr. Bronte <b>Organization:</b> CSIRO Oceans and Atmosphere <b>Address:</b> PO Box 1538 Hobart TAS 7001 Australia <b>Phone:</b> <b>Email:</b> bronte.tilbrook@csiro.au
<b>Investigator</b>	<b>Name:</b> van Ooijen, Dr. Erik <b>Organization:</b> CSIRO Oceans and Atmosphere <b>Address:</b> PO Box 1538 Hobart TAS 7001 Australia <b>Phone:</b> <b>Email:</b> erik.vanooijen@csiro.au
<b>Investigator</b>	<b>Name:</b> Neill, Craig <b>Organization:</b> CSIRO Oceans and Atmosphere <b>Address:</b> PO Box 1538 Hobart TAS 7001 Australia <b>Phone:</b> <b>Email:</b>
<b>Dataset</b>	<b>Funding Info:</b> Integrated Marine Observing System <b>Initial Submission (yyyymmdd):</b> 20160202 <b>Revised Submission (yyyymmdd):</b>
<b>Campaign/Cruise</b>	<b>Expocode:</b> 09FS20120208 <b>Campaign/Cruise Name:</b> KAI_1 <b>Campaign/Cruise Info:</b> <b>Platform Type:</b> <b>CO2 Instrument Type:</b> Equilibrator-IR or CRDS or GC <b>Survey Type:</b> Moored Buoy <b>Vessel Name:</b> Kangaroo Island <b>Vessel Owner:</b> CSIRO <b>Vessel Code:</b> 09FS
<b>Coverage</b>	<b>Start Date (yyyymmdd):</b> 20120208 <b>End Date (yyyymmdd):</b> 20121128 <b>Westernmost Longitude:</b> 136.3 E <b>Easternmost Longitude:</b> 136.6 E <b>Northernmost Latitude:</b> 35.75 S <b>Southernmost Latitude:</b> 35.95 S
<b>Variable</b>	<b>Name:</b> DATE <b>Unit:</b> YYYY-MM-DD hh:mm:ss <b>Description:</b> date and time of measurement
<b>Variable</b>	<b>Name:</b> LATITUDE <b>Unit:</b> degree +ve=N <b>Description:</b>
<b>Variable</b>	<b>Name:</b> LONGITUDE <b>Unit:</b> degree +=E

**Description:**

<b>Variable</b>	<b>Name:</b> xCO2_dry_SW <b>Unit:</b> micromol/mol <b>Description:</b> mole fraction of carbon dioxide (dry) in surface water and at equilibrator temperature and salinity
<b>Variable</b>	<b>Name:</b> SD_xCO2_dry_SW <b>Unit:</b> micromol/mol <b>Description:</b> standard deviation of 58 determinations over 30 seconds of XCO2_DRY_SW at each time stamp
<b>Variable</b>	<b>Name:</b> XCO2_DRY_SW_WOCE_FLAG <b>Unit:</b> <b>Description:</b> woce flag for XCO2_DRY_SW (good=2, questionable=3, bad=4)
<b>Variable</b>	<b>Name:</b> XCO2_DRY_AIR <b>Unit:</b> micromol/mol <b>Description:</b> mole fraction of carbon dioxide (dry) in air
<b>Variable</b>	<b>Name:</b> SD_XCO2_DRY_AIR <b>Unit:</b> micromol/mol <b>Description:</b> standard deviation of 58 determinations over 30 seconds of XCO2_DRY_AIR at each time stamp
<b>Variable</b>	<b>Name:</b> XCO2_DRY_AIR_WOCE_FLAG <b>Unit:</b> micromol/mol <b>Description:</b>
<b>Variable</b>	<b>Name:</b> fCO2_WET_SW <b>Unit:</b> microatmospheres <b>Description:</b> fugacity of carbon dioxide in seawater at sea surface temperature and salinity and 100% humidity
<b>Variable</b>	<b>Name:</b> SD_fCO2_WET_SW <b>Unit:</b> microatmospheres <b>Description:</b> standard deviation of 58 calculations over 30 seconds of fCO2_WET_SW at each time stamp
<b>Variable</b>	<b>Name:</b> fCO2_WET_SW_WOCE_FLAG <b>Unit:</b> <b>Description:</b> woce flag for fCO2_WET_SW (2=good, 3-questionable, 4=bad)
<b>Variable</b>	<b>Name:</b> D_fCO2 <b>Unit:</b> microatmospheres <b>Description:</b> $\Delta fCO_2 = (fCO_2\_WET\_SW - fCO_2\_WET\_AIR)$
<b>Variable</b>	<b>Name:</b> SD_D_fCO2 <b>Unit:</b> microatmospheres <b>Description:</b> standard deviation of 58 determinations of D_fCO2 at each time stamp
<b>Variable</b>	<b>Name:</b> D_fCO2_WOCE_FLAG <b>Unit:</b> <b>Description:</b> woce flag for D_fCO2 (2=good, 3-questionable, 4=bad)
<b>Variable</b>	<b>Name:</b> ATMOSPHERIC_PRESSURE <b>Unit:</b> <b>Description:</b> atmospheric pressure

<b>Variable</b>	<b>Name:</b> SD_ATMOSPHERIC_PRESSURE <b>Unit:</b> kPa <b>Description:</b> standard deviation of 58 measurements of ATMOSPHERIC_PRESSURE over 30 seconds at each time stamp
<b>Variable</b>	<b>Name:</b> ATMOSPHERIC_PRESSURE_WOCE_FLAG <b>Unit:</b> <b>Description:</b> woce flag for ATMOSPHERIC_PRESSURE (2=good, 3-questionable, 4=bad)
<b>Variable</b>	<b>Name:</b> EQUILIBRATOR_PRESSURE <b>Unit:</b> kPa <b>Description:</b> pressure of equilibrator
<b>Variable</b>	<b>Name:</b> SD_EQUILIBRATOR_PRESSURE <b>Unit:</b> kPa <b>Description:</b> standard deviation of 58 measurements of EQUILIBRATOR_PRESSURE over 30 seconds at each time stamp
<b>Variable</b>	<b>Name:</b> EQUILIBRATOR_PRESSURE_WOCE_FLAG <b>Unit:</b> <b>Description:</b> woce flag for EQUILIBRATOR_PRESSURE (2=good, 3-questionable, 4=bad)
<b>Variable</b>	<b>Name:</b> <b>Unit:</b> degree centigrade <b>Description:</b> sea surface temperature
<b>Variable</b>	<b>Name:</b> SEA_SURFACE_TEMPERATURE_WOCE_FLAG <b>Unit:</b> <b>Description:</b> woce flag for SEA_SURFACE_TEMPERATURE (2=good, 3=questionable, 4=bad)
<b>Variable</b>	<b>Name:</b> EQUILIBRATOR_TEMPERATURE <b>Unit:</b> degree centigrade <b>Description:</b> equilibrator temperature
<b>Variable</b>	<b>Name:</b> EQUILIBRATOR_TEMPERATURE_WOCE_FLAG <b>Unit:</b> <b>Description:</b> woce quality control flag for EQUILIBRATOR_TEMPERATURE (2=good, 3=questionable, 4=bad)
<b>Variable</b>	<b>Name:</b> SALINITY <b>Unit:</b> <b>Description:</b> sea surface salinity
<b>Variable</b>	<b>Name:</b> SALINITY_WOCE_FLAG <b>Unit:</b> <b>Description:</b> woce flag for SALINITY (2=good, 3=questionable, 4=bad)
<b>Variable</b>	<b>Name:</b> DISSOLVED_OXYGEN <b>Unit:</b> micromol/litre <b>Description:</b> dissolved oxygen
<b>Variable</b>	<b>Name:</b> SD DISSOLVED_OXYGEN <b>Unit:</b> micromol/litre <b>Description:</b> standard deviation of DISSOLVED_OXYGEN measurements
<b>Variable</b>	<b>Name:</b> DISSOLVED_OXYGEN_WOCE_FLAG

**Unit:**

**Description:** woce quality control flag for DISSOLVED\_OXYGEN (2=good, 3=questionable, 4=bad)

**Sea Surface Temperature**

**Location:** 1m on mooring next to equilibrator

**Manufacturer:** Sea-Bird Electronics

**Model:** SBE 16plusV2

**Accuracy:** 0.005 (°C if units not given)

**Precision:** 0.001 (°C if units not given)

**Calibration:** 26-Jan-10, factory calibrated before purchase.

**Comments:**

**Sea Surface Salinity**

**Location:** 1m

**Manufacturer:** Sea-Bird Electronics

**Model:** SBE 16plusV2

**Accuracy:** 0.01

**Precision:** 0.003

**Calibration:** 26-Jan-10, factory calibrated before purchase.

**Comments:**

**Atmospheric Pressure**

**Location:** Sensor is connected to an air block on mooring at 1m above sea level that is vented at the time of measurement

**Normalized to Sea Level:** yes

**Manufacturer:** LICOR

**Model:** LICOR 820 internal sensor

**Accuracy:** 0.5 kPa (hPa if units not given)

**Precision:** 0.01 kPa (hPa if units not given)

**Calibration:** 21/11/2011 based on laboratory comparison against Druck DPI 142 pressure indicator carried out pre and post deployment

**Comments:**

**Atmospheric CO2**

**Measured/Frequency:** Yes, 2 hourly

**Intake Location:** 1m above sea level

**Drying Method:** silica gel dried to 50-60% and relative humidity measurement used to correct for water vapour

**Atmospheric CO2 Accuracy:** 2 micromol/mol

**Atmospheric CO2 Precision:** 0.2 micromol/mol

**Aqueous CO2 Equilibrator Design**

**System Manufacturer:** Battelle

**Intake Depth:** 1

**Intake Location:** base of surface mooring buoy

**Equilibration Type:** headspace equilibrator as described in Sutton et al., 2014

**Equilibrator Volume (L):** 0.1

**Headspace Gas Flow Rate (ml/min):** 200

**Equilibrator Water Flow Rate (L/min):** see Sutton et al., 2014

**Equilibrator Vented:** Yes

**Equilibration Comments:**

**Drying Method:** partial using silica gel, typically 50-60% humidity and a relative humidity sensor is used to correct for water vapour

**Aqueous CO2 Sensor Details**

**Measurement Method:** IR

**Method details:** NDIR

**Manufacturer:** LI-COR

**Model:** 820

**Measured CO2 Values:** xCO2(dry)

**Measurement Frequency:** 2 hourly

**Aqueous CO2 Accuracy:** 2 micromol/mol  
**Aqueous CO2 Precision:** 0.2 micromol/mol  
**Sensor Calibrations:** Sensor deployment is checked each two hourly measurement cycle using a zero and span gas. The sensor was checked post deployment against a range of 4 CO2-in-air standards to ensure measurements are within 2 micromol/mol of reference standard values between zero and 450 micromol/mol  
**Calibration of Calibration Gases:** Ship  
**Number Non-Zero Gas Standards:** 1  
**Calibration Gases:**  
MANUFACTURER:NOAA Earth Systems Laboratory, USA  
CYLINDER NUMBER: JB02737  
GAS CYLINDER PRESSURE, PRE-DEPLOYMENT: 1900 psi  
GAS CYLINDER PRESSURE, POST-DEPLOYMENT: 1200 psi  
CO2-IN-AIR CONCENTRATION (WMO X2007): 530.25 PPM  
CALIBRATION DATE: 15/07/2009  
Zero gas reference is generated by circulating air through soda-lime at each measurement cycle.

**Comparison to Other CO2 Analyses:**

**Comments:**

**Method Reference:**

Sutton, A.J., C. L. Sabine, S. Maenner-Jones, N. Lawrence-Slavas, C. Meinig, R. A. Feely, J. T. Mathis, S. Musielewicz, R. Bott, P. D. McLain, H. J. Fought, and A. Kozyr (2014) A high-frequency atmospheric and seawater pCO2 data set from 14 open-ocean sites using a moored autonomous system. Earth System Science Data, 6, 353-366. doi:10.5194/essd-6-353-2014.

**Equilibrator  
Temperature Sensor**

**Location:** Tequ is the same as the Sea Surface Temperature, and is located next to the equilibrator

**Manufacturer:** Sea Bird Electronics

**Model:** SBE 16plusV2

**Accuracy:** 0.005 (°C if units not given)

**Precision:** 0.001 (°C if units not given)

**Calibration:** 26-Jan-10, factory calibrated before purchase.

**Comments:**

**Equilibrator  
Pressure Sensor**

**Location:** Airblock at about 1m above sea level is used to even the LI-COR pressure sensor

**Manufacturer:** LI-COR

**Model:** 820

**Accuracy:** 5 (hPa if units not given)

**Precision:** 0.1 (hPa if units not given)

**Calibration:** 21/11/2011 Based on laboratory comparison against Druck DPI 142 pressure indicator that were carried out pre and post deployment

**Comments:** Pequ is considered the same as Patm due to the venting of the LI-COR 820 pressure sensor through an air block at the time of each measurement

**Other Sensor**

**Description:** Dissolved oxygen

**Manufacturer:** Aanderaa

**Model:** 4175C

**Accuracy:** 1 micromol/litre

**Precision:** 1 micromol/litre

**Calibration:** PRE-DEPLOYMENT: 14-Jun-11 POST-DEPLOYMENT: 27-Feb-13

**Comments:** The optodes are calibrated at CSIRO, Hobart, using a purpose built calibration system, referenced to dissolved oxygen measurements made using modified Winkler titrations (Culberson, 1991). The calibrations cover a range of temperatures and oxygen concentrations that occur in the field and new calibration coefficients are generated to fit a Stern-Volmer equation (Uchida et al., 2008).

## **Additional Information**

**Suggested QC flag from Data Provider:** NA

**Additional Comments:** TThe CO<sub>2</sub>/acidification mooring data was sourced as part of the Integrated Marine Observing System (IMOS) – supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative. Users of these data are requested to cite the data source as below and to send copies of manuscripts to the PI prior to submission to ensure data are accurately represented.

**Citation for this Dataset:**

We rely on users of these data to recognise the effort required to obtain data by citing these data as:

B. Tilbrook, E. van Ooijen, C. Neill (2012) Integrated Marine Observing System fCO<sub>2</sub> timeseries measurements for the ocean and atmosphere from Kangaroo Island, Australia (35.838S,136.445E). <http://imos.aodn.org.au/imos123/>.

**Other References for this Dataset:**

<http://imos.aodn.org.au/imos123/>